

THE MINERAL INDUSTRY OF

GHANA

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The West African nation of Ghana covers an area of 238,540 square kilometers and supported a population of around 19.5 million in mid-2000. During the presidential election year of 2000, the economy experienced a downturn because of a high level of indebtedness, a high rate of inflation, a massive currency depreciation, and weak international prices for its major exports (cocoa, gold, and timber). The Ministry of Finance reported that the gross domestic product (GDP) grew at a rate of 3.7% in 2000, or 0.7% lower than that of 1999; inflation doubled to 25.2% at yearend 2000 from 12.4% at yearend 1999; the Ghanaian cedi (C) depreciated by more than 50% against the dollar from C3,550 at the beginning of the year to C6,800 at yearend; and Ghana's external debt totaled \$5.8 billion. Total indebtedness of \$7.5 billion was equal to 224% of exports, 709% of budget revenues, and 124% of the GDP (Ghana Ministry of Finance, March 9, 2001, The budget statement and economic policy of the Government of Ghana for the 2001 financial year, accessed May 5, 2001, at URL <http://www.ghanareview.com/Budget2001.htm#top>).

Ghana was the second largest gold producer in Africa after South Africa, the third largest African producer of aluminum metal and manganese ore, and a significant producer of bauxite and diamond. Production of major mineral commodities are listed in table 1. In addition, a number of industrial minerals, which included clays (kaolin), dimension stone, limestone, salt, sand and gravel, and silica sand, were produced on a small scale (Barning, 1997, p. 1). With the drop in gold prices and the subsequent efforts by the gold companies to rationalize production and costs, gold production appears to have peaked in Ghana at nearly 80 metric tons (t) in 1999. Gold production in 2000 decreased by 10% to 72 t compared with that of 1999. The decrease in gold production was attributed to the closure of the Teberbie Mine and surface mining operations at Ashanti Goldfields Co. Ltd.'s Obuasi Mine complex. On the basis of a review of all gold company closures, expansion, and new investment plans, gold production was expected to remain around 72 t in 2001. Development of Normandy Ghana Gold Ltd.'s new Yamfo-Sefwi gold deposit could see national production returning to the 76- to 79-t range between 2002 and 2004 but tapering off again as the known and economic gold resources at Bogosu Gold Ltd.'s (BGL) Bogosu Mine, Abosso Goldfields Ltd.'s Damang Mine, and Resolute Amansie Ltd.'s Obaton Mine become depleted. A 15% to 25% increase in the world gold price, however, could stimulate new exploration and access to lower grade ores and extend the life of these mines.

Provisional trade data for 2000 indicated an overall merchandise trade deficit of \$892 million. Total estimated exports declined to \$1,940.4 million compared with \$2,012.1 million in 1999. Mineral exports for 2000 were estimated to be approximately \$984 million, or about 51% of total exports.

Major mineral exports included \$702 million from gold, an estimated \$20.6 million from manganese, \$15 million from diamonds, and \$12.8 million from bauxite. Ghana's main processed mineral commodity export was primary aluminum, which was toll-refined by Volta Aluminum Co. (Valco) from imported alumina. On the basis of the average price of aluminum of \$1.65 per kilogram (\$0.75 per pound) in 2000, aluminum production of 142,000 t, most of which was exported, was valued at about \$235 million. Total imports of \$2,832.4 million declined by 12.3% from those of 1999. Imports of crude oil and refined oil products increased to \$520.1 million in 2000 from \$333.3 million in 1999 as a result of an increase in crude oil prices to more than \$30 per barrel from \$18 per barrel. Other mineral- or mining-related imports included alumina for aluminum production, clinker, gypsum and limestone for cement production, fertilizers, and sodium cyanide for gold leaching.

Structure of the Mineral Industry

Through privatization programs during the 1990s, the Government had greatly reduced its once-dominant stake in cement and gold companies but has maintained a controlling interest in Ghana Consolidated Diamonds Ltd., Ghana National Petroleum Corp. (GNPC), and the state-run Tema Steel Co.

Efforts to attract foreign investment in recent years have brought in a wide range of companies from Australia, Canada, Ireland, South Africa, the United Kingdom, and the United States, which held controlling interests in most of the mines in Ghana (table 2). The issuance of reconnaissance and prospecting licenses by the Ghana Minerals Commission dropped to 4 in 2000 from 62 in 1997 owing to the decrease in exploration risk capital and the weakening gold price, thus prompting the Ghana Chamber of Mines to ask for review of the 1986 Mining Law to increase incentives to foreign investors (Gri BEF News Ghana, April 5, 2001, Chamber of Mines calls for review of mining law, accessed May 5, 2001 at URL <http://mclglobal.com/History/Apr2001/d1bcal.html>). Kaiser Aluminum Corp. of the United States maintained its longstanding 90% interest in the Valco aluminum smelter and was the major consumer of hydroelectric power supplied by the state-owned Volta River Authority (VRA).

Commodity Review

Metals

Aluminum and Bauxite.—Valco's smelter at Tema Harbor was majority owned and operated by Kaiser Aluminum & Chemical Co. of the United States. Valco's fluctuating

operating level resulted from the amount of power that it has been allocated by the VRA under a contract agreement that is valid until 2017. VRA power allocations have been restricted by droughts and low water levels in the Akosombo Dam. The operating level at Valco between 1996 and 2000 has ranged from one to four out of a total of five potlines; during 2000, Valco operated an average of four potlines. Subject to Parliamentary approval in 2001, Valco and the VRA reached an agreement that would provide for sufficient power to operate at least four of Valco's five potlines in 2001 and at least three and one-half potlines thereafter (Kaiser Aluminum & Chemical Corp., March 30, 2001, Form 10-K for 2000 to U.S. Securities and Exchange Commission, accessed May 5, 2001, at URL <http://www.sec.gov/Archives/edgar/data/54291/0000950129-00-001099.txt>).

Ghana Bauxite Co. Ltd. (GBC), which was owned by Alcan Aluminum Ltd. of Canada, operated the country's only bauxite mine at Awaso, which has been in production since 1941. In 2000, GBC operated at slightly over its nominal capacity of 500,000 metric tons per year of salable bauxite. GBC planned an expansion program to increase export capacity to 1 million metric tons per year (Mt/yr) of bauxite by 2003, which would also require an upgrade of the railroad from the mine to the export harbor at Takoradi.

Gold.—Of the 11 major gold mines in operation in Ghana in 2000, the 4 largest accounted for a total of nearly 70% of the recorded gold output of the country—the Obuasi (27.7%), the Tarkwa (15.6%), the Damang (13.7%), and the Bibiani (11.8%). A breakdown of gold production, by mine, from 1996 to 2000 is listed in table 3.

In 2000, Ashanti's corporate gold production from seven mines in Ghana, Guinea, Tanzania, and Zimbabwe totaled 54,035 kilograms (kg), of which approximately 66% was from operations in Ghana compared with 78% in 1999. The decline from Ghana's total share in Ashanti's production was because of the closure of the high-cost Obuasi surface mining and leaching operations in Ghana and the opening of its new Geita Mine in Tanzania during 2000. By mid-2000, all production of underground sulfide ore at Obuasi was optimized to produce at a rate of 17,100 kilograms per year (kg/yr) of gold. All underground ore passed through the upgraded Sulphide Treatment Plant (STP), which used the bacterial leaching process (BIOX) to treat 3 Mt/yr of ore. The company began to recover from its hedging-related liquidity crisis of 1999 owing mainly to its sale of a 50% interest in the Geita gold project to AngloGold Ltd. for \$205 million in cash and a commitment by AngloGold to provide \$130 million of the project financing to the Geita project. Ashanti reduced its total debt level by 47% from its peak in 1999 to \$366 million during 2000. The company was continuing to restructure its gold hedge book to minimize its exposure to margin calls by 2003 (Ashanti Goldfields Co. Ltd., 2001, p. 2-6).

Production increased by 4% to 5% at Ashanti's Bibiani and Iduapriem Mines but dropped by 18% at the Ayanfuri Mine compared with that of 1999. During 2000, work at Obuasi included continued development work and track installation on the main haulage level to the north and south of the mine, sinking and lining of the Sansu ventilation shaft, and

development and support of the Kwesi Renner Shaft crusher station. Exploration focused on upgrading ore from resource to reserve status and locating extensions of the reserves at the Obuasi deposit.

The Iduapriem Mine was nearing depletion by yearend 1999; in late 2000, however, Ashanti purchased the Teberebie Mine, which is immediately south of Iduapriem, from Pioneer Goldfields Ltd. of the United States for \$18.8 million. The acquisition of this mine would provide Ashanti with additional ore reserves of 37.2 million metric tons (Mt) at a grade of 1.71 grams per metric ton (g/t) gold that will extend the life of the Iduapriem Mine by more than 9 years (Ashanti Goldfields Co. Ltd., 2001, p. 10). Ashanti, in turn, signed an agreement to sell Teberebie's North Pit, gyratory crusher, and heap-leach pads to Gold Fields (Ghana) Ltd., which was the owner of the Tarkwa Mine; the mine is adjacent to the northeastern boundary of Teberebie (Ashanti Goldfields Co. Ltd., May 12, 2000, Ashanti Goldfields Co. Ltd. announces acquisition of Pioneer Goldfields Ltd., accessed June 1, 2000, at URL <http://www.ashantigold.com/12may2000.htm>). The sulfide reserves, which were no longer economically treatable at Teberebie's heap-leach operation, would be trucked to the Iduapriem carbon-in-leach (CIL) plant for treatment. After operating at a loss for 3 years, Pioneer decided to discontinue its operations at Teberebie during the second quarter of 1999 and ended mining by yearend (Pioneer Goldfields Ltd., March 22, 2000, Form 10-K, U.S. Securities and Exchange Commission, accessed August 11, 2000, at URL <http://www.sec.gov/Archives/edgar/data/733060/0000950135-00-001553.txt>). During 2000, Ashanti continued to leach the ore stacked at Teberebie where 839 kg of gold was recovered.

On January 25, 2000, Ashanti purchased Birim Goldfields Inc. of Canada's Dunkwa-Mampon property and its 21,770-kg gold resource for \$1.5 million and future royalties. Approximately 30% of the gold resource at Mampon is extractable by open pit. Mampon is along the Ashanti structural trend and south of Obuasi. The Dunkwa-Mampon property had been previously held by Battle Mountain Gold Co. of the United States (Birim Goldfields Inc., 2000, p. 5).

At the end of 2000, Ashanti reported measured and indicated resources of 187.3 Mt at an average grade of 4.36 g/t gold, of which underground measured and indicated resources at Obuasi accounted for 56 Mt at a grade of 10 g/t gold, at its four mines in Ghana. The total reported measured and indicated resources estimates represented more than 817 t, or 25 million ounces of contained gold. Reported proved and probable ore reserves at its four mines in Ghana as of December 31, 2000, were estimated by Ashanti to be 101 Mt at an average grade of 4.39 g/t gold, of which underground proved and probable reserves at Obuasi accounted for 41.8 Mt at a grade of 7.9 g/t gold (Ashanti Goldfields Co. Ltd., 2001, p. 22).

Gold Fields held a 71% interest in and operated the new Tarkwa surface mine and heap-leaching operation, which was the second largest gold operation in Ghana. Underground mining at Tarkwa, which had produced gold from the quartz pebble "Banket" conglomerate of the upper Tarkwaian Group since 1878, ceased operations in October 1999. On the basis of company quarterly reports for calendar year 2000, the Tarkwa surface mine, in its second full year of operation, processed 8.8

Mt of ore that yielded an average of 1.25 g/t gold and a total of 11,272 kg of gold; this was a 66% increase compared with that of 1999 (Gold Fields Ghana Ltd., [undated], Individual mine quarterly history, accessed February 9, 2001, at URL http://www.goldfields.co.za/quart_hist/qrt_hist_f.htm).

In addition to planned phased development of the Tarkwa operation, production increases were attributed to the acquisition of certain of Teberebie Mine assets from Ashanti in August. For \$4.4 million, Gold Fields acquired Teberebie heap-leach pads and associated crushing, agglomeration, and stacking facilities as well as approximately 31,100 kg of Teberebie North Pit gold resources, all of which were adjacent to the Tarkwa Mine. The crushing system processed 300,000 metric tons per month and, when fully integrated with Tarkwa, would bring crushing capacity to 11 Mt/yr and gold production levels to 12,440 kg/yr in the near term. Gold Fields expected to complete its feasibility study on Phase III development of Tarkwa by mid-2001. Phase III would expand the metallurgical complex through the construction of screening and desliming operations, as well as a mill to process deeper and less porous ore. A go-ahead decision on Phase III would bring Tarkwa up to its full planned capacity of more than 15,550 kg/yr of gold [Gold Fields (Ghana) Ltd., August 25, 2000, Gold Fields Ghana completes acquisition of Teberbie assets, Press Release, accessed September 2, 2000, at URL http://www.goldfields.co.za/pre_ann/press/press2000/2000august25.html].

The company reported the following resources and reserves at its Tarkwa Mine as of June 30, 2000, based on a gold price of \$285 per troy ounce and a cutoff grade of 0.5 g/t gold. Near-surface measured, indicated, and inferred resources at Tarkwa were estimated to be 285.8 Mt of ore at an average grade of 1.5 g/t gold for a total resource of 440,180 kg of contained gold, of which proven and probable reserves were estimated to be 142.9 Mt at an average grade of 1.4 g/t gold for a total resource of 201,800 kg of contained gold. Reserve estimates were based on a \$300 per ounce gold price and a 0.5-g/t cutoff for Tarkwa. An additional 12,750 kg of gold was contained in probable reserves at Teberbie (Gold Fields Ltd., September 1, 2000, Commentary—Summary of resources and reserves at Gold Fields' operations—Annual report of Gold Fields Ltd. for 2000, accessed February 12, 2001, at URL http://www.goldfields.co.za/annual_report/ar2000/commentary.htm).

Abosso, which was owned by Ranger Minerals Ltd. of Australia, operated the Damang gold mine and CIL plant, which were located 30 kilometers (km) northeast of Tarkwa. Production shown in table 3 for Damang was for calendar years 1998 to 2000. For Ranger Minerals' financial year that ended June 30, 2000, however, Abosso had mined 3.94 Mt of run-of-mine ore at a grade of 3.05 g/t gold and 1.89 Mt of low- and medium-grade ore that averaged 1.21 g/t gold. An additional 7.7 Mt of waste was removed. The mill treated 4.12 Mt of ore at a grade of 2.81 g/t to yield 10,805 kg of gold based on a 93% recovery rate (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 June 2000, accessed September 11, 2000, via URL <http://www.ranger.com.au>). During the 6 months that ended on December 31, 2000, Damang began treating a higher proportion of primary ore and milled 2.27 Mt of ore at an average grade of 2.51 g/t gold and refined 5,068 kg of gold. By yearend, mine stockpiles

included 709,000 t of run-of-mine high-grade ore that averaged 2.45 g/t gold and 10.4 Mt of low- and medium-grade material that averaged 1.08 g/t gold (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 December 2000, accessed May 11, 2001, via URL <http://www.ranger.com.au>).

New mineral resources estimates, which were based on exploration drilling during the second half of 2000, were reported as of March 31, 2001, using a long-term gold price of \$300 per ounce. Proven and probable reserves were reported to be 15.32 Mt of in situ material at a grade of 2.26 g/t gold and 9.1 Mt of stockpiled ore at a grade of 1.25 g/t gold. Total measured, indicated, and inferred resources were estimated to be 41.6 Mt at a grade of 2.26 g/t gold. Ranger also announced resource estimates for the Lima-Kwesi placer gold prospect, which was located on the eastern limb of the Damang anticline. Measured, indicated, and inferred oxide resources at Lima-Kwesi were estimated to be 5.3 Mt at a grade of 0.99 g/t gold. Ranger planned to access this material in early 2003 during the postmining phase at Damang to supplement the milling of fresh medium-grade ore. Drilling of a similar prospect, Tomento, on the western limb of the anticline was continuing (Ranger Minerals Ltd., 2000, Financials—Quarterly reports—Quarterly report ending 31 March 2001, accessed May 11, 2001, via URL <http://www.ranger.com.au>).

Resolute Amansie (owned by Resolute Ltd. of Australia) operated the Obotan gold mine and CIL plant. Obotan was located near Manso-Nkran, which is 47 km west of Obuasi. With the depletion of near-surface oxide ore at the Adubiaso Hill section of the mine, Resolute Amansie installed a new secondary/tertiary crusher to treat the harder primary ore encountered during 2000. The company also was installing a small oxygen plant to inject oxygen into the CIL circuit to increase dissolved oxygen and recovery rates. The new oxygen plant was expected to be operational by March 2001. According to quarterly reports for calendar year 2000, Resolute Amansie milled 1.72 Mt of ore at Obotan at grades that ranged from 2.38 to 2.87 g/t gold at recovery rates that averaged between 96% and 98.2%. During 2000, 4,199 kg of gold was produced; this was more than its original planned output levels of 3,730 kg/yr of gold (Resolute Ltd., Latest news—Quarterly reports, accessed May 3, 2001, via URL <http://www.resolute-ltd.com.au>). Resolute Amansie reported reserve and resources as of June 30, 2000, for Obotan and the Konongo project, which was inactive in 2000. Obotan contained 1.34 Mt of proved reserves at a grade 2.5 g/t gold and 0.59 Mt of probable reserves at a grade of 2.4 g/t gold. Obotan reserves were contained within mineral resources estimated to be 4.16 Mt measured resources at a grade of 2.4 g/t gold, 2.24 Mt of indicated resources at a grade of 2.8 g/t gold, and 0.6 Mt of inferred resources at a grade of 3.8 g/t gold. Measured, indicated, and inferred gold resources at Konongo were estimated to be 3.75 Mt at a grade of 2.4 g/t gold, 4.47 Mt at a grade of 1.7 g/t gold, and 5.6 Mt at a grade of 2.1 g/t gold, respectively (Resolute Ltd., September 27, 2000, Resolute Ltd. annual report for 2000, accessed May 3, 2001, via URL <http://www.resolute-ltd.com.au>).

Satellite Goldfields Ltd., which was owned by Glencar Mining plc. of Ireland through its Wassa Holdings Ltd.

subsidiary, operated the Wassa gold open pit and heap-leach project, which was located about 35 km northeast of Tarkwa. During early 2000, Glencar installed a new leach pad designed to allow improved solution control and management and ultimately gold recovery rates; the heap leach operation had problems with poor gold recovery since its startup in 1998. The new leach system helped increase production to 3,266 kg in 2000 from 2,712 kg in 1999. Following continuing poor leach recovery results in the first 2 months of 2001 and its inability to meet its planned design rate of 4,043 kg/yr of gold, Glencar announced that it was unlikely to recover its more than \$40 million investment in the Wassa Mine (Glencar Mining plc., March 5, 2001, Wassa update, Press Release, accessed May 2, 2001, at URL <http://www.glencarmining.ie/press/2001.htm>). Proven and probable ore reserves as of December 31, 1999, were 15.1 Mt at a grade of 1.52 g/t. Measured and indicated resources were estimated to be 32 Mt at a grade of 1.34 g/t gold (Glencar Mining plc., 2000, p. 1-8). Glencar continued its exploration of several properties near the Wassa Mine and by yearend 2000 had announced the discovery of gold mineralization—at the Ballyebo prospect, which is 2 km southwest of the Wassa Mine, and at the Bawdia Bosso prospect, which is 2 km west of the Wassa Mine (Glencar Mining plc., December 12, 2000, Gold found on second exploration target at Wassa, Press Release, accessed May 2, 2001, at URL <http://www.glencarmining.ie/press/2000.htm>).

BGL operated the Bogosu Mine and the CIL plant, which were located between Prestea and Dunkwa. During its first full year of operation by the new owners Golden Star Resources Ltd. of Canada and Anvil Mining NL of Australia, BGL, which struggled with low gold prices and poor recovery rates, produced 3,378 kg of gold; this was a decrease of 17% compared with that of 1999. The decreased output in 2000 was attributed to lower gold recovery and lower throughput of transitional ores through the mill. Gold recovery rates declined to 64.4% from 81.4% in 1999. In April 2001, Golden Star bought out Anvil's 20% interest in BGL in exchange for 3 million shares of Golden Star stock, which was valued at \$1.2 million. Mining operations at Bogosu were scheduled to end by mid-2001; milling operations would continue into early 2002 using stockpiled ore. Golden Star was conducting a feasibility study on developing a sulfide mining operation at Bogosu that was scheduled for completion in early 2001 and also negotiating with Barnato Exploration Ltd. and the Prestea Mine's employee group Prestea Gold Resources Ltd. to acquire the old Prestea mine property, which adjoins the southern boundary of the Bogosu mining lease. The Government's abrogation of Barnato's rights to mine at Prestea late in 2000 added a complication to the negotiations (Golden Star Resources Ltd., April 19, 2001, Golden Star announces 2000 yearend and fourth quarter financial results, Press Release, accessed May 2, 2001, at URL <http://www.gsr.com/pr190401.html>). Golden Star reported proven and probable oxide and transition (mixed oxide and sulfide) ore reserves as of December 31, 2000, using a \$280 per troy ounce gold price, to be 2.46 Mt at a grade of 2.2 g/t gold. In addition, estimates of additional mineralized material, which were based on a gold price of \$300 per troy ounce, included 1.95 Mt of oxide and transition resources at a grade of 1.95 g/t and 11.3 Mt of sulfides at a grade of 3.4 g/t gold

(Golden Star Resources Ltd., 2001, p. 5-6).

During 2000, Bonte Gold Mines Ltd. (owned by Akrokeri-Ashanti Gold Mines Inc. of Canada) increased production by 41% to 2,134 kg of gold from the small alluvial mining operation on the Jeni River. Production was forecast to reach more than 2,364 kg of gold in 2001. Bonte's proven and probable ore reserves were estimated, as of January 1, 2001, to be at about 7,200 kg of contained gold; significant exploration potential was located in 4 million cubic meters of gold-bearing gravels identified at the nearby Jeni property during 2000 (Akrokeri-Ashanti Gold Mines, Inc., March 14, 2001, Akrokeri-Ashanti announces results of 2000 exploration program on Jeni property, Press Release, accessed May 11, 2001, at URL http://www.aagm.com/press/14%20Mar%2001_pf%20press_release.htm).

Normandy Ghana [owned by Normandy Mining Ltd. of Australia (90%)] continued to progress with exploration and feasibility work on its Yamfo-Sefwi project. The project was located in the Yamfo-Sefwi greenstone belt in west-central Ghana near Sunyani and Kenyasi about 60 km east of the border with Côte d'Ivoire. Normandy Mining reported mineral resources, as of June 30, 2000, to be 42.2 Mt of measured resources at a grade of 2.3 g/t, 16.8 Mt of indicated resources at a grade of 2.2 g/t, and 16.7 Mt of inferred resources at a grade of 2.0 g/t gold. In addition, the company held a 42.3% joint-venture interest in Moydow Mines International Inc.'s adjacent Area E (Ntotoroso) property where inferred resources were reported to be 14 Mt at a grade of 2.6 g/t gold. The two deposits have a combined gold content of 205,600 kg (6.61 million troy ounces). The completed feasibility study on the Yamfo-Sefwi project estimated that capital costs of \$152 million would be required to develop 15 pits at Bosumkese, Kenyase, Subenso, and Yamfo and a treatment plant with an initial capacity of 3.5 Mt/yr, which would process oxide (40%) and sulfide (60%) ore. The plant flowsheet incorporated primary crushing, semiautogenous grinding, and ball milling followed by a CIL circuit. A feasibility study to incorporate Moydow's Ntotoroso deposit, which was based on toll processing of Ntotoroso ore at the Yamfo-Sefwi treatment plant and an increase in plant capacity to 5 Mt/yr of ore, was expected to be completed by mid-2001 (Normandy Mining Ltd., 2000, p. 15-17). In April 2001, Normandy received approval for a mining lease for Area E from the Government and signed an agreement with Franco-Nevada Mining Corp. Ltd., which would give Franco-Nevada a 19.9% equity interest in Normandy.

Chirano Gold Mining Ltd. [owned by Red Back Mining NL of Australia (95%)] continued exploration drilling at its Chirano property, which was located adjacent to the GBC bauxite mine at Awaso. Indicated mineral resources were reported to be 13.8 Mt at a grade of 2.3 g/t gold in seven prospects along 4 km of the Chirano Shear Zone at Akota extension, Akota North, Obra Paboase, Sariehu, Suraw, and Tano. Additional inferred mineral resources were estimated to be 5.31 Mt at a grade of 2.1 g/t gold (Red Back Mining NL, 2000, 2000 Red Back Mining NL annual report, accessed May 12, 2001, at URL <http://www.redbackmining.com.au/>). Feasibility studies completed during 2000 were based on a \$300 per ounce gold price and on mining 1.5 Mt/yr of ore to produce 3,515 kg/yr of

gold during a 6.6-year mine life. In early 2001, Ashanti made an offer to buy Chirano, which was rejected by Red Back as too low. Ashanti was seeking the Chirano ore as feed for its nearby Bibiani plant, which will run out of mine feed in late 2003. Subject to locating stand-alone financing or negotiating a better offer from Ashanti, Red Back was concentrating on expanding the gold resource base with further exploration at Chirano in 2001 (Red Back Mining NL, March 2001, Quarterly report for March 2001, accessed May 12, 2001, at URL <http://www.redbackmining.com.au/>; Red Back Mining NL, 2000).

Manganese.—Ghana Manganese Company Limited's Nsuta-Wassaw open pit mine near Tarkwa was the only producer of manganese ore in Ghana. Benefitting from recent investment in upgrading mining equipment and optimizing mine plans, production of manganese ore increased to 895,669 t of manganese ore from 638,937 t in 1999. The metal content of the ore was between 32% and 34% manganese.

Industrial Minerals

Cement.—Ghana Cement Works Ltd. (Ghacem) operated the country's only two cement plants at the port cities of Takoradi and Tema. Each plant had the capacity to produce 1.2 Mt/yr of cement by using imported clinker, gypsum, and limestone. During 1999, Heidelberg Zement AG of Germany acquired a 94.5% interest in Ghacem from Scancem International AG of Norway (60%) and the Government. The company operated essentially as a monopoly but faced increasing competition from cement imported from Togo in 1999 and 2000.

Diamond.—The majority of diamond was recovered by artisanal miners from alluvial and raised terrace gravel workings in the Birim Valley. On the basis of sales to the Precious Metals Marketing Corporation in 2000, artisanal output was reported to be 686,551 carats with an average sales value of \$16.88 per carat. Production from Ghana Consolidated Diamonds Ltd.'s Akwatia diamond mine was not available for 2000; in 1999, however, 205,025 carats with an average sales value of \$19.80 per carat was produced. Akwatia is located about half way between Accra and Kumasi and was the only formal operating diamond mine in Ghana.

Other Industrial Minerals.—Carmeuse Lime Products (Ghana) Ltd. (owned by Carmeuse S.A. of Belgium) operated out of Sekondi and produced limestone and lime, as well as seashells, which were supplied to Ashanti for use in its BIOX gold-treatment plant at Obuasi. The Ministry of Mines estimated that from 20,000 to 30,000 people were involved in the small-scale production of industrial minerals, which included kaolin, limestone, salt, and sand and gravel.

Mineral Fuels

In 1999, GNPC produced an estimated 6,000 barrels per day (bbl/d) of crude oil from the Saltpond field. In March 2000, Dana Petroleum plc and GNPC announced the discovery of oil in the offshore Western Tano Contract Area with a flow rate of up to 1,000 bbl/d (U.S. Energy Information Administration, June

2000, Ghana—Oil, Country Analysis Brief, accessed October 12, 2000, at URL <http://www.eia.doe.gov/emeu/cabs/ghana.html>).

Ghana's only petroleum refining facility was the 45,000-bbl/d Tema oil refinery outside of Accra. It was operated by Tema Oil Refinery Co. (TOR) (a subsidiary of GNPC). TOR primarily processed imported Bonny Light/Brass River crudes from Nigeria and produced a variety of refined products for domestic consumption and export. In 1997, TOR's refining capacity was expanded to 45,000 bbl/d from 25,000 bbl/d. In February 1999, GNPC signed a \$185 million contract with the Republic of Korea's Samsung Group to build a residual fluid cracking tower at TOR. The project was scheduled to be completed in 2002 and will help boost TOR's production of gasoline and distillates. GNPC also planned to conduct a feasibility study on the construction of a cogeneration plant at TOR. The project, which may be developed as an independent powerplant, will be fueled by gas, which, as of 1999, was being flared at the facility. The size of the plant will be determined by the study, and any excess power generated would be sold to the national grid (U.S. Energy Information Administration, June 2000, Ghana—Refining and downstream oil activities, Country Analysis Brief, accessed October 12, 2000, at URL <http://www.eia.doe.gov/emeu/cabs/ghana.html>).

In a major example of West African regional cooperation and good economic planning, a plan was put in place to use Nigerian natural gas, which is currently (2000) being flared, to help solve the long-term energy needs of the neighboring states of Benin, Ghana, and Togo. By using Nigeria's more-than 40 trillion cubic feet of natural gas reserves, a consortium led by Chevron Nigeria Ltd. has committed to build the West African Gas Pipeline by 2002. The \$400 million project will involve the construction of an 800-km offshore gas pipeline from the Niger Delta to the west coast city of Effuasi, Ghana. The pipeline will supply an initial amount of 120 million cubic feet per day of gas to existing and planned powerplants in Benin, Ghana, and Togo. Cooperators in the West African Gas Pipeline Project include Nigerian National Petroleum Corporation, GNPC, Shell Petroleum Development Company, Société Togolese de Gaz, and SA Société Béninoise de Gaz (Chevron Nigeria Ltd., August 16, 1999, Chevron named project manager for West African Gas Pipeline project, Press Release, accessed August 17, 1999, via URL <http://www.chevron.com/newsvs/frame.html>; allAfrica.com, November 13, 2000, West African Gas Pipeline co-operating for energy security, accessed January 20, 2001, at URL <http://allafrica.com/stories/200011130108.html>).

In February 1999, the Government announced plans for a new power system development policy to eliminate the power outages that plagued the economy in 1998. The plan called for Government involvement in joint-venture projects and in expediting licensing of private sector power projects. In 1999, construction began on the joint-venture project with the VRA to add 330 megawatts (MW) to the Takoradi thermal power complex, which will be completed between 2000 and 2001. GNPC also commissioned construction of a 125-MW power barge facility and associated transmission lines financed by the Japanese Government. Other power-generation projects included a joint venture that involved the Electricity

Corporation of Ghana in restoring 80 MW of generation capacity and upgrading the distribution network within the Tema industrial estate before yearend 2000 and the 220-MW independent thermal power project being sponsored by the mining companies to assure themselves of long-term reliable power supply, particularly for the bauxite, gold, limestone, and manganese industries.

Outlook

Despite a favorable political and investment climate, the prospects for continued development of the key mining sector of the Ghanaian economy were threatened by continued weak commodity prices, particularly for gold in 1999 and 2000, and by high energy costs. Weak gold and cocoa prices have reduced the foreign exchange generation capacity of the country and began to slow the economy in 2000. Owing to periodic droughts, domestic energy supply, especially hydroelectric power, has been a problem, particularly for the aluminum industry and the expanding needs of the gold industry. Although new gas-fueled powerplant developments will help mitigate this problem, the long-term solution rested with implementation of the West Africa Gas Pipeline.

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Other Publication

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TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

| Commodity 2/ | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|----------|----------|-------------|-----------|--------|
| Aluminum: | | | | | |
| Bauxite, gross weight | 473 | 504 | 442 | 355 r/ | 504 |
| Metal, smelter, primary | 137 | 152 | 56 | 104 | 142 |
| Arsenic, trioxide 3/ | 5,443 | 4,577 | 5,000 e/ | 7,000 | -- e/ |
| Cement, hydraulic 4/ | 1,500 e/ | 1,700 e/ | 1,630 r/ | 1,870 | 1,950 |
| Diamond: | | | | | |
| Gem e/ | 572 | 664 | 649 | 544 | 736 |
| Industrial e/ | 143 | 166 | 160 | 136 | 184 |
| Total 5/ | 715 | 830 | 809 | 680 r/ | 920 e/ |
| Gold 6/ | 49,211 | 54,662 | 72,541 | 79,946 r/ | 72,080 |
| Manganese: | | | | | |
| Ore, processed | 448 | 437 | 537 | 639 r/ | 896 |
| Mn content e/ | 152 | 149 | 172 | 204 r/ | 287 |
| Petroleum: | | | | | |
| Crude | 2,600 | 2,600 | 2,190 | 2,190 | 2,200 |
| Refinery products: e/ | | | | | |
| Liquefied petroleum gas | 365 7/ | 350 | -- r/ 7/ | 625 | 625 |
| Gasoline | 3,285 7/ | 3,300 | 1,460 r/ 7/ | 5,850 | 5,850 |
| Jet fuel | 365 7/ | 350 | 365 r/ 7/ | 625 | 625 |
| Kerosene | 1,095 7/ | 1,100 | 730 r/ 7/ | 1,950 | 1,950 |
| Distillate fuel oil | 2,555 7/ | 2,500 | 1,460 r/ 7/ | 4,450 | 4,450 |
| Residual fuel oil | 730 7/ | 700 | 1,460 r/ 7/ | 1,250 | 1,250 |
| Other including refinery fuel and losses e/ | 730 7/ | 700 | 1,825 r/ 7/ | 1,250 | 1,250 |
| Total | 9,490 7/ | 9,000 | 7,300 r/ 7/ | 16,000 | 16,000 |
| Salt e/ | 50 | 50 | 50 | 50 | 50 |
| Silver, content of exported dore e/ | 2,460 r/ | 2,730 r/ | 3,630 | 3,950 | 3,630 |
| Steel, secondary, rebar e/ | 25 | 75 r/ | 75 r/ | 75 | 75 |

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through April 2001.

2/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced, as are limestone and lime for processing of some gold ore, and salt. Output of these commodities is not reported and information is inadequate to make reliable estimates of output levels.

3/ Reported data from Ashanti Goldfields Co. for 1996-97. Bogoso gold ore roaster closed in 1996. AGC-Obuasi roaster closed in June 2000.

4/ All from imported clinker.

5/ Production, in thousand carats, includes that of Akwatia Mine (1996--271; 1997--300 (estimated); 1998--252; 1999--205; 2000--233. Remainder are artisanal sales to the Precious Metals Marketing Corp. Estimates of unreported artisanal production are not included.

6/ Does not include estimate of smuggled or undocumented production.

7/ Reported figure.

TABLE 2
GHANA: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|--------------------|----------------------|---|---|----------------------------|
| Aluminum | thousand metric tons | Volta Aluminum Co. Ltd. (Valco), (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Aluminum Co., 10%) | Aluminum smelter at Tema | 200. |
| Bauxite | do. | Ghana Bauxite Co. Ltd. (Alcan Aluminum Ltd., 80%; Government, 20%.) | Bauxite mine at Awaso | 500. 1/ |
| Cement | do. | Ghana Cement Works Ltd. (Heidelberg Zement AG of Germany, 94.5%) | Clinker grinding plant at Takoradi, | 1,900. |
| Do. | do. | Do. | Tema | 1,200. |
| Diamond | thousand carats | Ghana Consolidated Diamonds Ltd. (Government, 100%) | Placer mine at Akwatia | 360. |
| Gold | kilograms | Ashanti Goldfields Co. Ltd. [Depositary Nominee, Inc. (Ashanti), 36.1%; Lonmin, Plc., United Kingdom, 31.5%; Government, 19%; other private, 13.4%] | Obuasi underground mine (surface mines phasing out by mid-2000) | 28,000. |
| Do. | do. | do. | Iduapriem Mine | 5,000. |
| Do. | do. | do. | Bibiani Mine | 5,000. |
| Do. | do. | do. | Ayanfuri Mine | 1,800. |
| Do. | do. | Ashanti Goldfields total capacity in Ghana | | 39,800. |
| Do. | do. | Abosso Goldfields Ltd. [Ranger Minerals Ltd. (Australia), 90%; Government, 10%] | Damang Mine near Tarkwa | 9,000. |
| Do. | do. | Barnex (Prestea) Ltd. [Barnato Exploration Ltd. (South Africa), 90%; Government, 10%]. Sold to employees in 1999 as Prestea Gold Resources Ltd. | Prestea underground mine closed September 1998 | 1,100. |
| Do. | do. | Bogosu Gold Ltd. (Golden Star Resources Ltd. (Canada), 90%; Government, 10%) | Open pit mine at Bogosu (oxide mining phasing out in 2001) | 3,100. |
| Do. | do. | Bonte Gold Mines Ltd. (Akrokeri-Ashanti Gold Mines, Inc., Canada, 85%; Government, 10%; Buosiako Co. Ltd., Ghana, 5%) | Placer mine at Jeni, about 40 kilometers southwest of Kumasi | 1,100. |
| Do. | do. | Dunkwa Continental Goldfields Ltd. (closed in 2000) | Offin River dredging operation, along border of Ashanti and Central Regions | 175. |
| Do. | do. | Gold Fields (Ghana) Ltd. (Gold Fields of South Africa Ltd., 71.1%; Repadre Capital Corp. of Canada, 18.9%; Government, 10%). | Tarkwa open pit mines and heap leach (full capacity planned by 2003) | 11,820 (15,550). |
| Do. | do. | Midras Mining Limited | Asikam alluvial mine (closed 2000) | 250. |
| Do. | do. | Prestea Sankofa Gold Ltd. | Prestea tailings retreatment operation | 650. |
| Do. | do. | Resolute Amansie Ltd. [Resolute Ltd. (Australia), 90%; Government, 10%] | Obotan Mine 40 kilometers northwest of Obuasi | 4,160 to 4,666 in future. |
| Do. | do. | Satellite Goldfields Ltd. [Wassa Holdings Ltd., 90% (of which Glencar Mining plc. of Ireland holds 66%); Government, 10%] | Wassa Mine, 30 kilometers northeast of Tarkwa. | 3,730. |
| Do. | do. | Teberebie Goldfields Ltd. (Pioneer Group Inc., United States, 90%; Government, 10%) | Teberebie open pit mine near Tarkwa (closed in 2000) | 8,000. e/ |
| Limestone and lime | | Carneuse Lime Products (Ghana) Ltd. (Carneuse S.A. of Belgium, 100%) | Sekondi | NA. |
| Manganese ore | thousand metric tons | Ghana Manganese Company Limited (Government, minority interest) | Open pit mine at Nsuta-Wassaw in Western Region | 650 (processed ore). |
| Petroleum, crude | thousand barrels | Ghana National Petroleum Corp. (Government, 100%) | Saltpond Field | 2,190 |
| Petroleum products | do. | Tema Oil Refinery Co. (Government, 100%) | Refinery at Tema | 16,500 (crude input). |
| Steel | do. | Ferro Fabrik | Steel mill at Tema (secondary) | 20 (rod, rebar, and wire). |
| Do. | do. | Tema Steel Co. [subsidiary of Ghana Industrial Holdings Co. (Government, 100%)] | do. | 25 (rebar). |
| Do. | do. | Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%) | do. | 30 (rod, rebar, and wire). |

e/ Estimated. NA Not available.

1/ To double capacity to 1 million metric tons by 2001.

TABLE 3
GHANA: GOLD PRODUCTION BY COMPANY AND MINE

(Kilograms)

| Company | Mine | 1996 | 1997 | 1998 | 1999 | 2000 |
|--------------------------------------|--|--------|--------|--------|----------|--------|
| Abosso Goldfields Ltd. | Damang, open pit | -- | -- | 8,421 | 9,446 | 9,881 |
| Ashanti Goldfields Co. Ltd. | Ayanfuri, open pit 1/ | 1,717 | 1,807 | 1,440 | 1,382 | 1,130 |
| Do. | Bibiani | -- | -- | 4,719 | 8,146 | 8,513 |
| Do. | Iduapriem, open pit 2/ | 3,669 | 4,560 | 4,828 | 5,092 r/ | 5,191 |
| Do. | Asikam, alluvial (Midras Mining Ltd.) 3/ | -- | -- | 233 | 34 | -- |
| Do. | Obuasi, open pit and underground | 26,761 | 26,687 | 27,537 | 23,113 | 19,937 |
| AGC Total | | 32,147 | 33,054 | 38,757 | 37,767 | 34,771 |
| Barnex (Prestea) Ltd. | Prestea, underground 4/ | 1,062 | 1,011 | 600 | 894 | -- |
| Bogosu Gold Ltd. 5/ | Bogosu, open pit | 3,327 | 3,464 | 3,813 | 4,058 r/ | 3,379 |
| Bonte Gold Mines Ltd. | Esaase and Jeni River, placer | 668 | 879 | 1,093 | 1,515 r/ | 2,134 |
| Dunkwa Continental Goldfields Ltd. | Dunkwa, placer 6/ | 173 | 118 | 37 | 1 | -- |
| Gold Fields (Ghana) Ltd. | Tarkwa, underground 7/ | 1,476 | 1,672 | 1,670 | 1,269 | -- |
| Do. | Tarkwa, open pit, 1998 startup | -- | -- | 2,522 | 6,806 | 11,272 |
| Obenemasi Gold Mines Ltd. | Konongo/Obenemasi, open pit | 588 | 176 | -- | -- | -- |
| Precious Minerals Marketing Corp. 8/ | Artisanal workings | 2,913 | 3,331 | 1,873 | 2,302 r/ | 1,968 |
| Prestea Sankofa Gold Ltd. | Prestea Sankofa, tailings 9/ | 540 | 626 | 467 | 373 | 371 |
| Resolute Amansie Ltd. | Obotan, open pit | -- | 2,151 | 5,411 | 4,230 r/ | 4,199 |
| Satellite Goldfields Ltd. | Wassa, open pit, 1999 startup | -- | -- | -- | 2,712 r/ | 3,266 |
| Teberebie Goldfields Ltd. 10/ | Teberebie, open pit | 6,317 | 8,180 | 7,877 | 8,573 | 839 |
| Grand total | | 49,211 | 54,662 | 72,541 | 79,946 | 72,080 |

r/ Revised. -- Zero.

1/ Acquired in purchase of Cluff Resources in 1996; 1,659 kilograms attributed to Ashanti in 1996.

2/ Acquired in merger with Golden Shamrock in 1996; 590 kilograms attributed to Ashanti in 1996.

3/ Sold by Ashanti in 1999 and closed in 2000.

4/ Acquired by Barnex (Prestea) Ltd. (JCI Ltd. of South Africa) from State Gold Mining Corp. (SGMC) in 1996.

5/ Acquired by Golden Star Resources Ltd. (U.S.), 70%, and Anvil Mining NL (Australia), 30%, in 1999.

6/ Acquired from SGMC in 1995.

7/ Acquired by Gold Fields Ltd. of South Africa from SGMC in 1993.

8/ Includes 8 to 110 kilograms per year of byproduct gold from Ghana Consolidated Diamonds Ltd.'s Akwatia Mine. Includes gold purchases from small-scale miners by Miramex and other licensed buying authorities.

9/ Acquired by Ashanti in purchase of SAMAX, Inc. in 1998; sold in 1999. Included in Ashanti's total for 1998.

10/ Acquired by Ashanti (ore reserves) and Gold Fields (heap-leach facilities) in mid-2000.

Sources: Ghana Minerals Commission and Ghana Chamber of Mines.